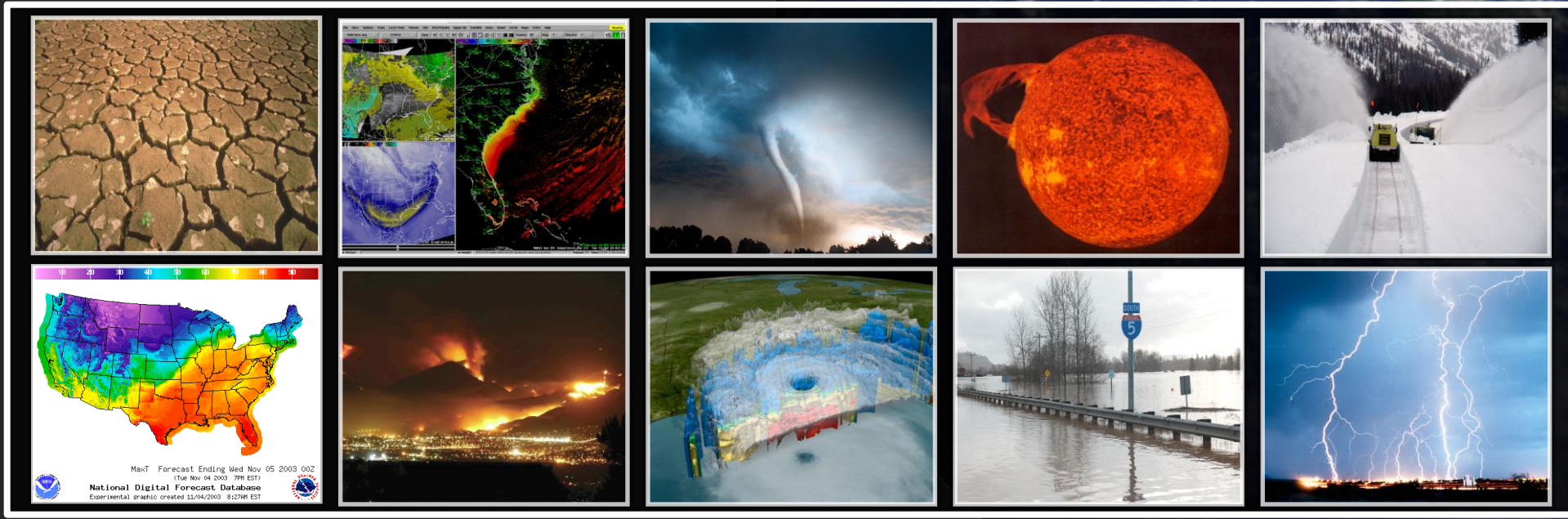
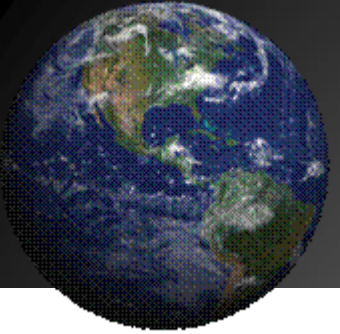
National Weather Service Partners Meeting

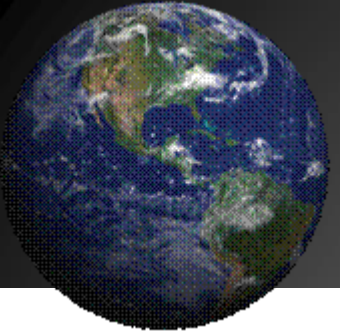
Science & Technology Integration
New Orleans, LA
Thursday, January 14, 2016





BUDGET HIGHLIGHTS

- FY16 STI Appropriation: ~$138M
- Major Programs/Activities:
  - Next Generation Global Prediction System Development (NGGPS)
  - Mid-range (weeks 3-4) prediction (FY16 -)
  - COASTAL Act modeling (FY16)
  - Space Weather Testbed (FY16 -)
  - Joint Tech. Transfer Initiative (OAR, FY16)
  - External Grants (NGGPS, HFIP, Testbeds, CSTAR, JTTI)



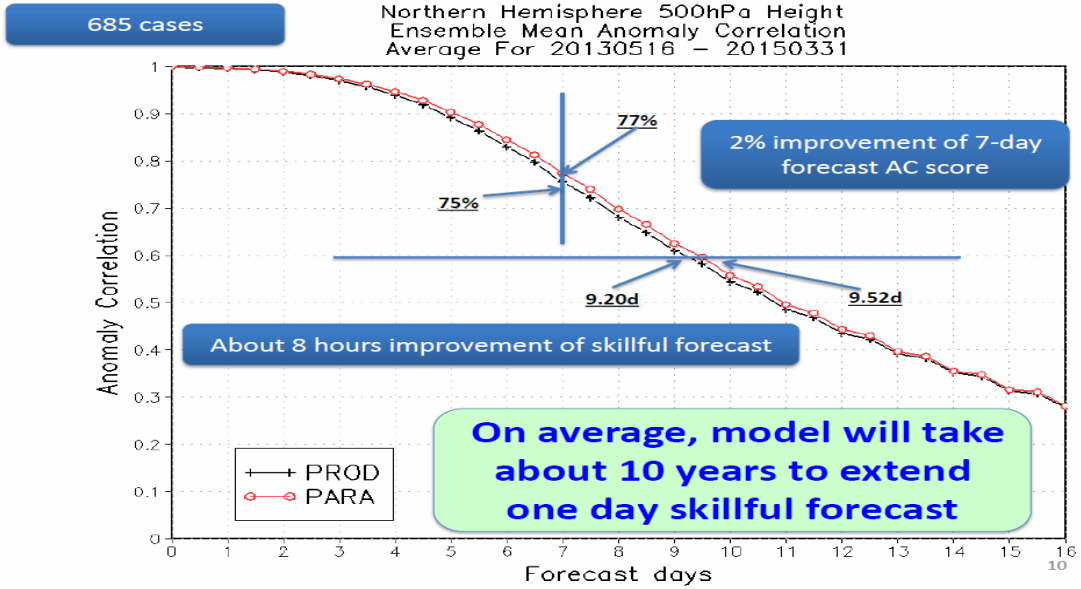
OPERATIONAL MODEL UPGRADES

Operational Model Upgrades :

- Global Ensemble Forecast System (GEFS)
- Global Forecast System (GFS)
- Rapid Refresh(RAP)/High Res. Rapid Refresh (HRRR)
- North American Mesoscale Rapid Refresh (NAMRR)
- Hurricane Weather Research and Forecasting model (HWRF)
- Next Gen. Global Prediction Sys. Dynamic Core Evaluation

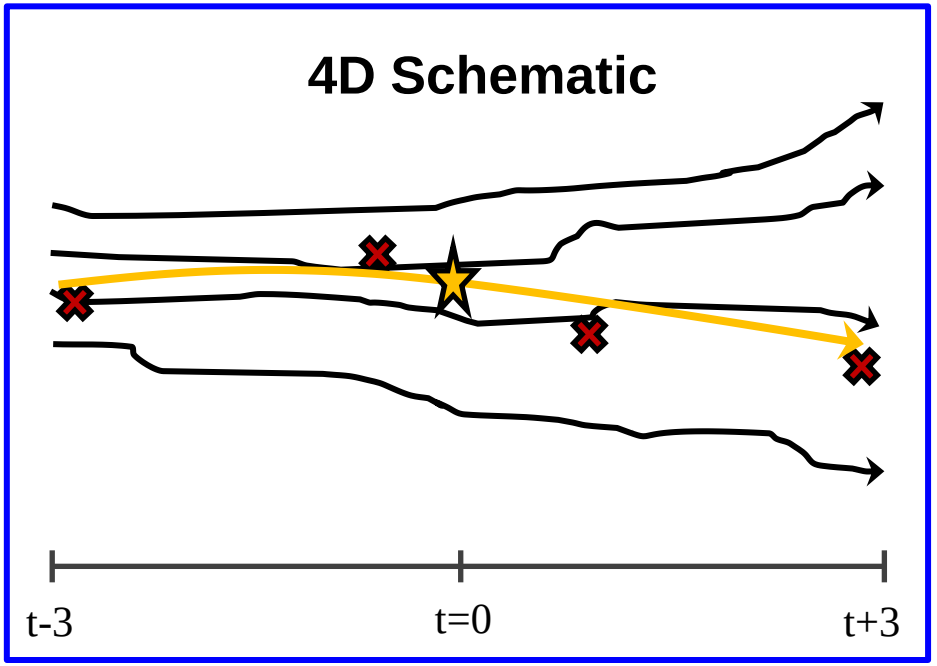
Global Ensemble Forecast System v.11 (Dec. 2015)

	V10.0.0	V11.0.0
GFS Model	Euler, 2012	Semi-Lagrangian, 2015
Resolution 0-192 h	T254 (52km) L42 (hybrid)	T_L574 (34km) L64 (hybrid)
Resolution 192-384 h	T190 (70km) L42 (hybrid)	T_L382 (52km) L64 (hybrid)
Output resolution	1^O x 1^O	0.5^O x 0.5^O and 1^O x 1^O
Output frequency	6h	3h the first 8 days; 6h the rest



Global Forecast System (GFS) and Global Data Assimilation System (GDAS) (May 2016)

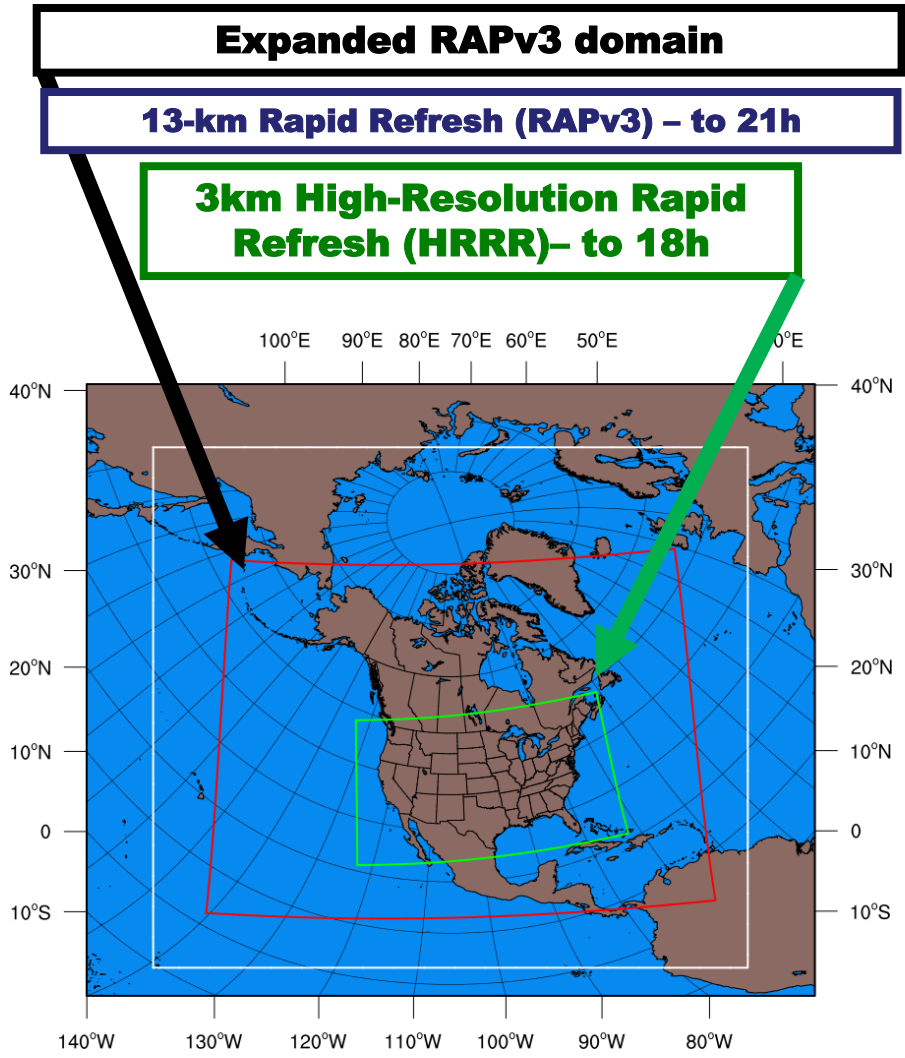
- **4D Hybrid Ens. Var. Data Assim.**
- **Preliminary Evaluation:**
  - Very significant improvement to short range forecasts (days 1, 3)
  - Days 5, 6 probably significantly improved, need longer evaluation periods
  - Smaller scales, winds show more improvements
  - Effect on hurricanes, precipitation—need longer evaluation periods
  - Effect on CONUS near surface fields—regime dependence



- 4D increment constructed by figuring out best combination of 4D ensemble perturbations
- Weights constant throughout window
- Use temporal correlations within each member to extract time information in obs

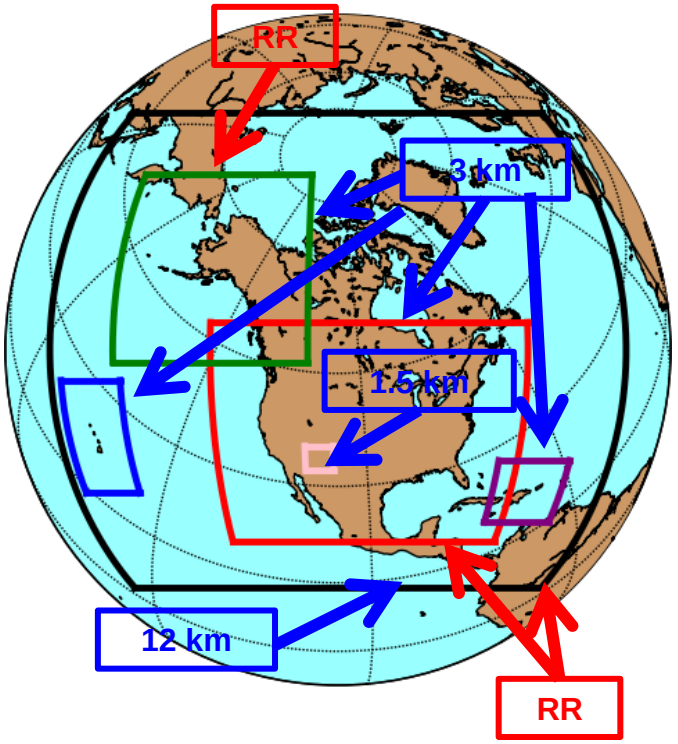
Rapid Refresh (RAP.v3) and High Resolution Rapid Refresh (HRRR.v2) (May 2016)

Component	RAPv3/HRRRv2 changes to remove RAPv2 warm/dry bias
GSI Data Assimilation	Canopy water cycling Temp pseudo-innovations thru model boundary layer More consistent use of surface temp/dewpoint data
GFO Convective Parameterization	Shallow cumulus radiation attenuation Improved retention of stratification atop mixed layer
Thompson Microphysics	Aerosol awareness for resolved cloud production Attenuation of shortwave radiation
MYNN Boundary Layer	Mixing length parameter changed Thermal roughness in surface layer changed Coupling boundary layer clouds to RRTMG radiation
RUC Land Surface Model	Reduced wilting point for more transpiration Keep soil moisture in croplands above wilting point



North American Mesoscale Forecast System (NAMRR) (June 2016)

Hourly-Updated NAM Forecast System



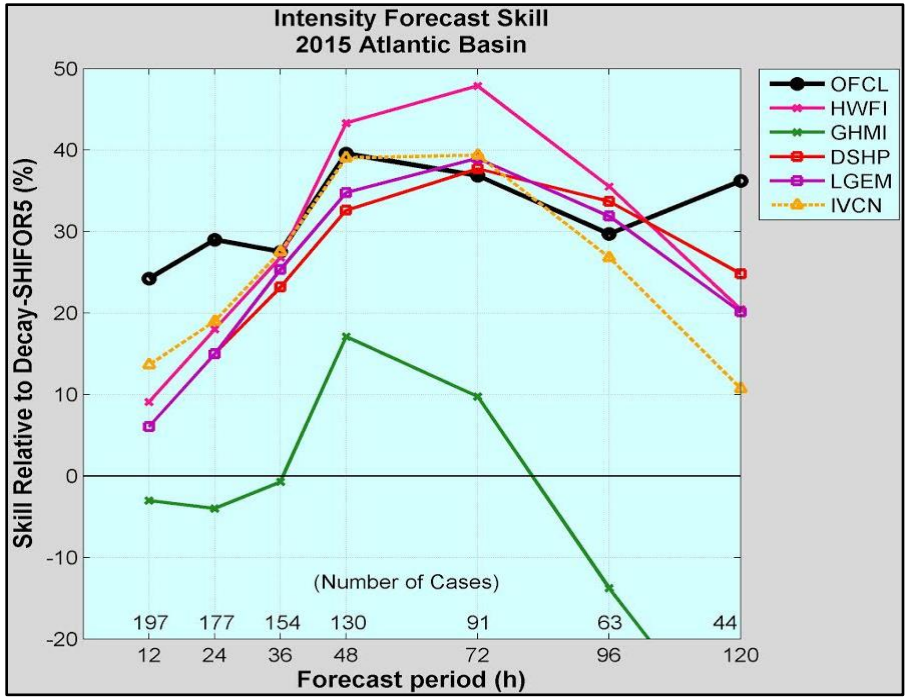
- Consistency with HRRR & allows for HREF
  - CONUS nest from 4 km to 3 km
  - Alaska nest from 6 km to 3 km
- Placeable Fire Weather nests use 1.5 km grid
- Hourly runs to 18 hr CONUS & Alaska

Developmental NAMRR webpage: http://www.emc.ncep.noaa.gov/mmb/jcarley/namrr/CONUSNEST

Hurricane Research and Weather Forecast Model (HWRF) (2016)

Planned HWRF Model improvements for 2016 hurricane season

- **Dynamic and Baseline Upgrades**
  - **First time:** Support up to eight storms in operations
- **Physics upgrades**
- **Ocean/Wave Coupling**
  - **First time:** ATMOS/Ocean/WAVE three-way coupling
- **Data Assimilation**



Next Generation Global Prediction System
Dynamic Core Evaluation Phase-1 (2015)

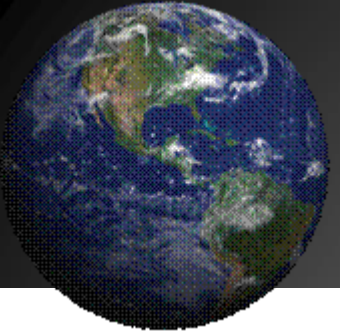
NGGPS Phase 1 Testing
Project Summary Assessment

	Idealized Tests	3-km, 3-day forecasts	Performance	Scalability	Nesting or Mesh Refinement	Software Maturity
FV3 (GFDL)						
MPAS (NCAR)						
NIM (ESRL)						
NMM-UJ (NCEP)						
NEPTUNE (Navy)						

 Meets or exceeds readiness for needed capability

 Some capability but effort required for readiness

 Capability in planning only or otherwise insufficiently ready



ENABLE/ENHANCE SERVICES

Enable/Enhance Operational Services:

- Air Quality (Experimental PM2.5 Prediction)
- National Blend of Models (NBM)
- Experimental Days 4-7 Winter Weather Outlooks
- Experimental Week 3-4 Outlooks
- Storm Surge Services
- Nearshore Wave Prediction System (NWPS)

Air Quality Prediction (Jan. 2016)

Model updates:

- Link NAM-CMAQ model with global NGAC dust predictions through lateral boundary conditions (LBCs)
- Increase vertical resolution from 22 to 35 layers
- Include analog forecast technique for bias correction of fine particulate matter (PM2.5) predictions

Fine particulate matter (PM2.5) prediction impacts:

- Provide to the public PM2.5 predictions, which include contributions from anthropogenic and natural sources, including wildfire smoke and windblown dust
- Improve model predictions of PM2.5
- Include bias correction postprocessing

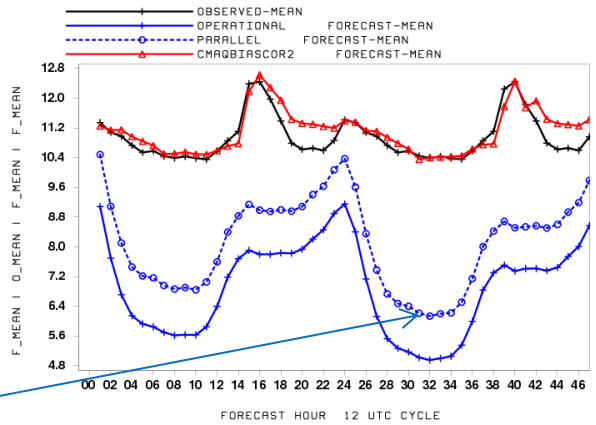
Ozone prediction impacts:

- Small impacts from this update

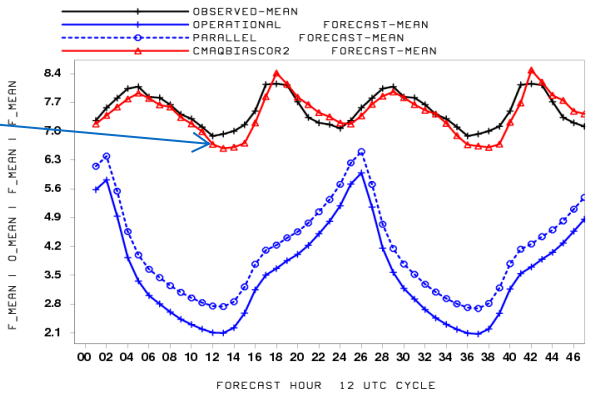
Dissemination:

- Operational air quality predictions of ozone, wildfire smoke and windblown dust are displayed at http://airquality.weather.gov/

PM2.5 in Eastern US



PM2.5 in Western US



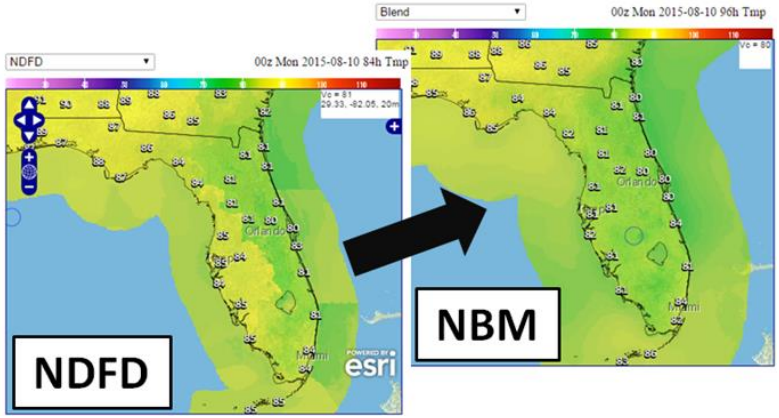
Testing shows that LBCs reduce prediction bias (blue circles). Analog technique (red) almost eliminates bias against observations (black).

National Blend of Models (v1.0) (Jan. 2016)

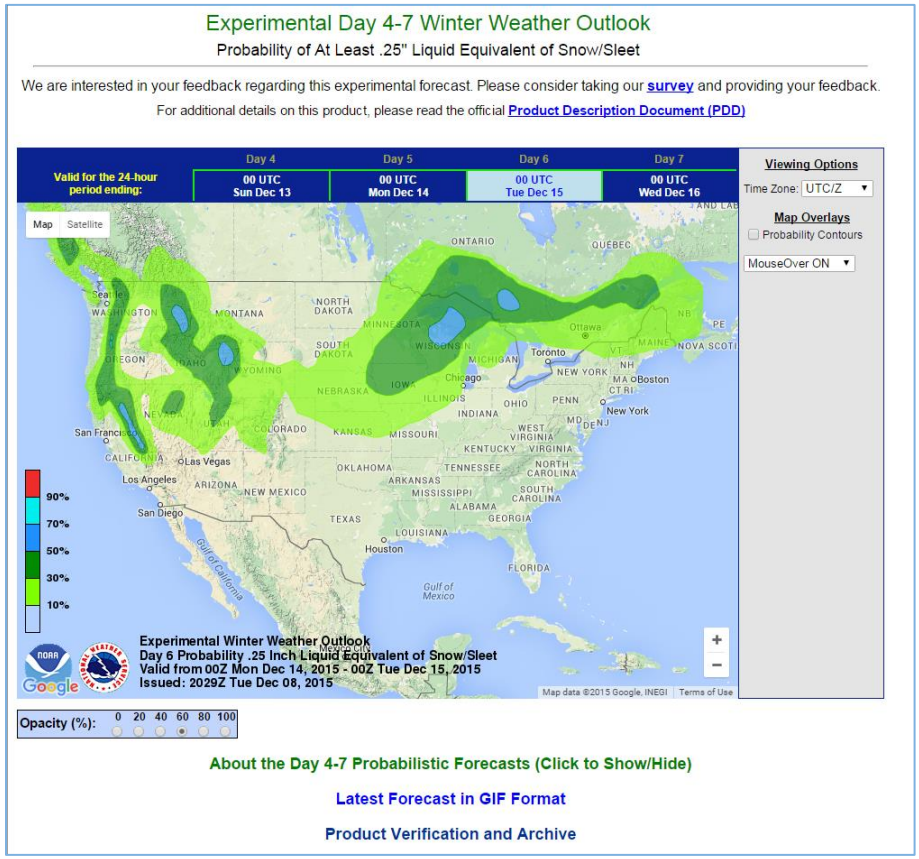
Objective: Improve quality and consistency of the NWS National Digital Forecast Database (NDFD)

Project Goals:

- Develop a set of foundational gridded guidance products for the NDFD weather elements based on NWS and non-NWS model information
- Create a methodology for a national blend ("best") from multiple models, optimized for the Day 3-8 time frame and extensible to all NDFD elements covering days 1-10



Experimental Days 4-7 Probability of Winter Weather



http://www.wpc.ncep.noaa.gov/wwd/pwpf_d47/pwpf_medr.php

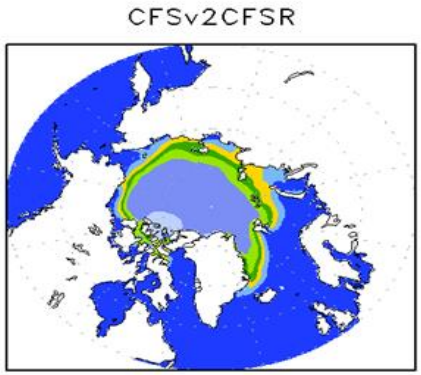
- Probability of >0.25” liquid equivant of snow (~2-4” snowfall) in 24 hrs (e.g., day 6)
- Publicly Experimental this season (feedback welcome!)
- *Plan to make experimental grids in NDFD in the 2016-7 season.*

Experimental Seasonal Arctic Sea Ice Outlook (2015)

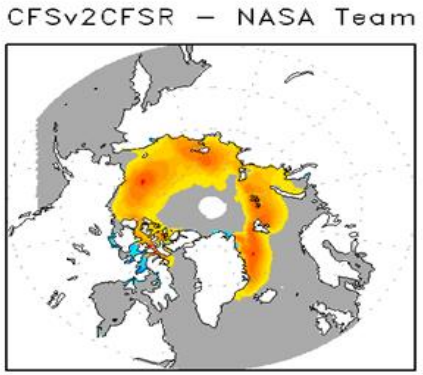
CPC started providing Experimental Arctic Sea Ice Outlooks to the NWS Alaskan Region in March 2015

- Outlooks are issued once per month for March to October ICs and extend for 9 months.
- 3 Improvements over baseline CFSV2 system:
  - Improved sea-ice initial conditions (PIOMAS from U. Washington).
  - Modified atmospheric physics (stratus clouds)
  - Modified ocean physics (heat flux constraint)
- Experimental outlooks show increased skill and reduced mean bias compared to operational CFSV2

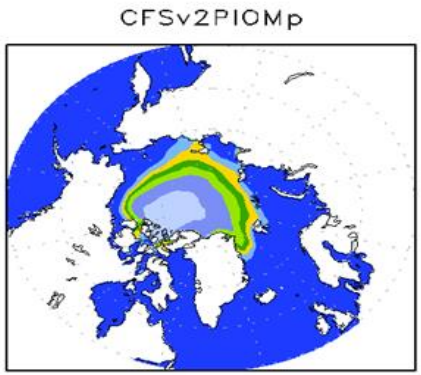
March IC Forecast Verifying in October for Years 2005-2014



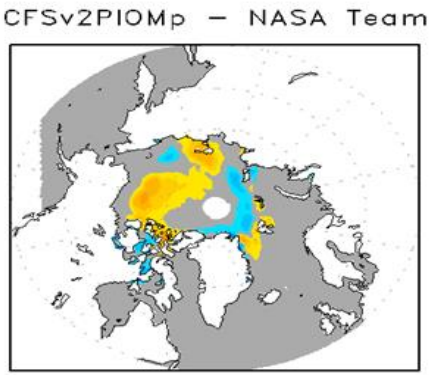
CFSV2



CFSV2 Error



EXP.



EXP. Error

Experimental Week 3-4 Temperature and Precipitation Outlooks

Issued by the Climate Prediction Center

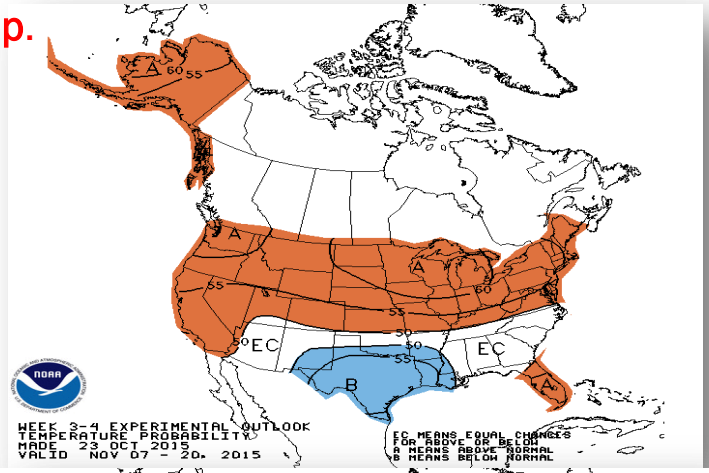
- Uses forecast tools developed by **CPC, Scripps/GFDL, ESSIC, and ESRL PSD.**
- Issued once per week on Friday afternoon
- Forecasts are 2-class (above/below) as opposed to traditional 3-class tercile probabilities.

- Users can provide feedback on product via web: http://www.cpc.ncep.noaa.gov/products/predictions/WK34/

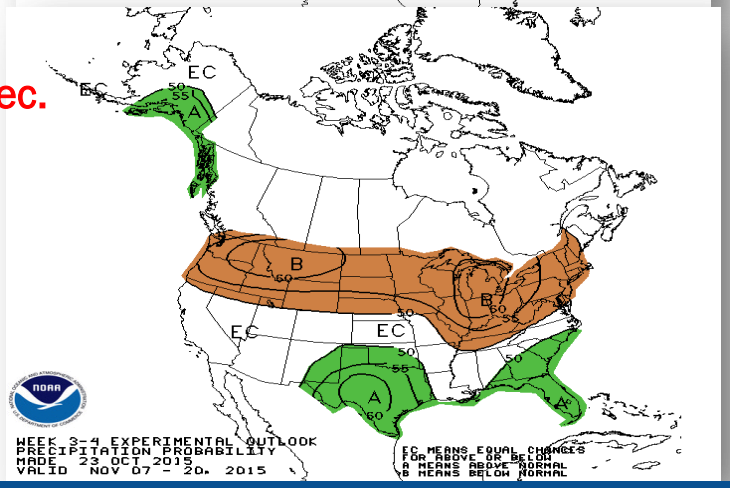
- Forecasts of opportunity depending on presence of large-scale, short-term climate drivers such as ENSO and MJO.

Forecast Valid for Nov. 7-20, 2015

Temp.

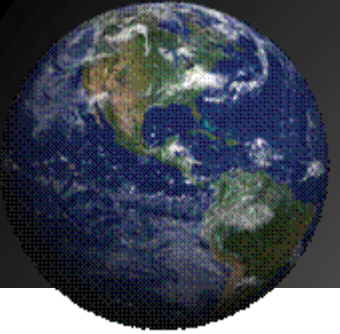


Prec.



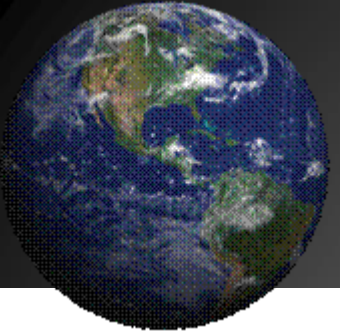
Nearshore Wave Prediction System (NWPS)
(Implementation at Coastal WFOs)

- Provides high-resolution local wave forecast guidance in the nearshore, produced on-demand by WFOs, within the new AWIPS II system
- Establishes a pilot for central execution of local applications on WCOSS
- Enable rip current and wave run-up prediction capability
- Rollout of centrally-executed NWPS begins in Jan-Feb 2016



NWS/STI GRANTS

- 48 ongoing collaborative projects
- $4.7M total funding planned for FY16
- R2O/NGGPS Projects: 23
- Hurricane Forecast Improvement (HFIP) Projects: 13
- CSTAR Projects: 12



SLIDES NOT LISTED IN OUTLINE/ BACK UP SLIDES

Storm Surge Watch and Warning Service

2015-2016: Publicly available prototype storm surge watch/warning graphic

- Collaborated NHC/WFO graphic available via NHC website, hurricanes.gov
- Statement in Hazard Section of the NHC Public Advisory
- Statement and geographic reference in WFO Hurricane Local Statement (HLS)

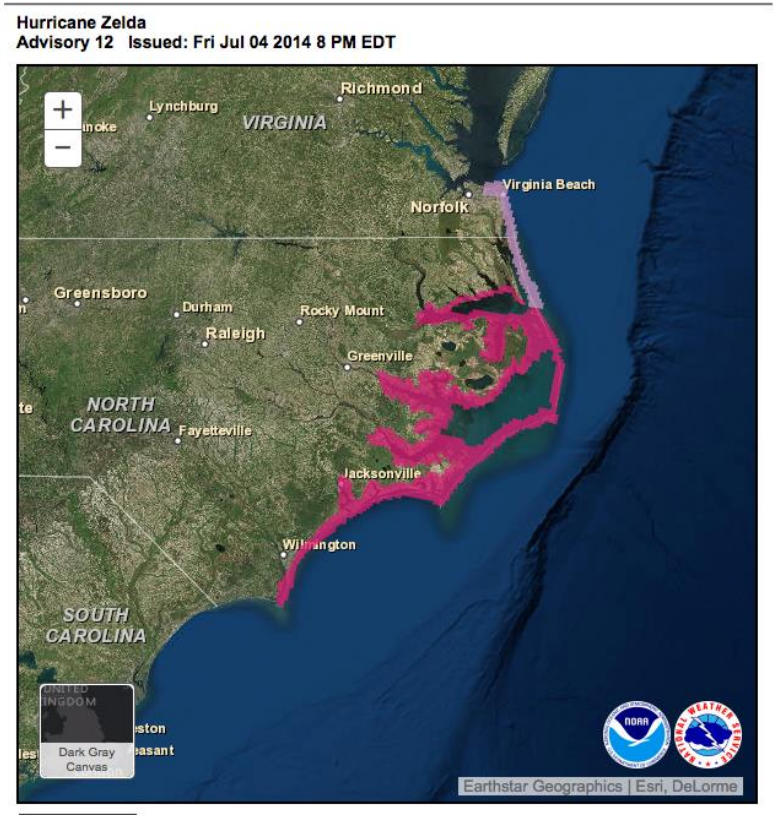
2016: Development of enhanced national TCV to include storm surge

- Inland and coastal wind watches/warnings merged in national TCV – limited non-real-time testing
- Storm surge watch/warning VTEC added to national and local TCVs – limited non-real-time testing
- Tests of Gridded version for the NWS WWA map and NDFD

2017: Full operational implementation

- Storm surge watch/warning, including text products, TCV, graphics, and gridded data, implemented operationally

Prototype Storm Surge Watch/Warning Graphic*



Impacts Catalog

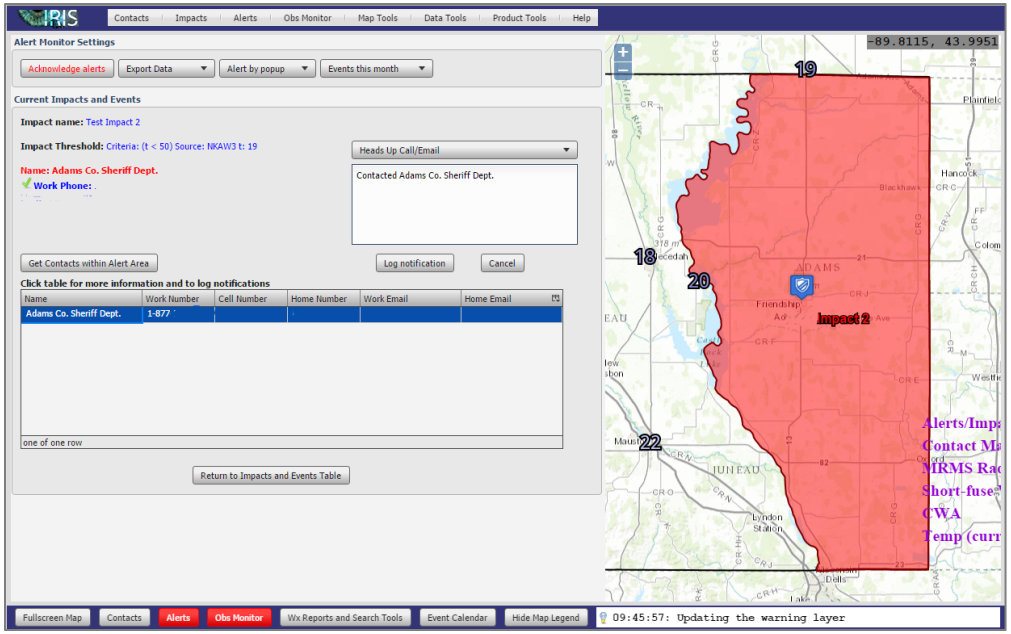
Goal: Develop a centralized database of weather-, water-, and climate-dependent societal impact information to allow the NWS to support data-driven decision making in the provision of DSS and the issuance of hazards products.

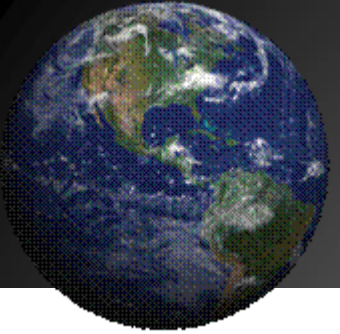
FY 15 Accomplishments

- Completed Requirements Definition for version 1.0 (beta)
- Migrated development system to Integrated Dissemination Program

FY 16 Plans

- Migrate operational system to Integrated Dissemination Program
- Operational Test and Evaluation of Impacts Catalog version 1.0 (beta)





Model Upgrades

Global Forecast System (GFS) and Global Data Assimilation System (GDAS)

The 4D Hybrid En-Var (cont)

GCWMB real time (pr4devb)
period: 2015070100 - real time (since 2015110100 frozen system)
•monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devb/

GCWMB 2012 Sandy retrospective (pr4devbs12)
Monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbs12/

GCWMB 2013 summer retrospective (pr4devbs13)
period: 2013041500 - 2013120100 (230 days)
monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbs13/

NCO 2013-2014 winter retrospective
period: 2013110100 - 2014060100 (212 days)
monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbw13/
above link points at http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/pr4devbw13/

NCO 2014 summer retrospective
period: 2014050100 - 2014120100 (214 days)
monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbs14/
above link points at http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/pr4devbs14/

GCWMB 2014-2015 winter retrospective (pr4devbw14)
period: 2014110100 - 2015050100 (181 days)
monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbw14/ before 20150114:
•http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbw14_before_20150114/

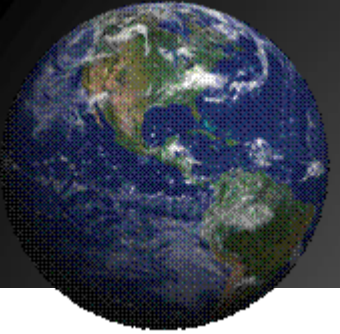
GCWMB 2015 summer retrospective (pr4devbs15)
period: 2015041500 - 2015120100 (230 days)
• monitoring/verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/pr4devbs15

Model Upgrades

Hurricane Research and Weather Forecast Model (HWRF)

Test Plan and Upgrade Schedule: 2016 HWRF

	Sensitivity Tests	GFS Upgrade 2015 HWRF	Infrastructure Upgrades (Baseline)	Physics Test	Wave Model Test	Final 2016 HWRF Test	EMC/NCO Transition
	Multiple	H16Z	H16B	H16P	H16W	H216 (EMC)	HWRF (NCO)
Detail	Old GFS Various HWRF sensitivity tests	New GFS Old HWRF with minimal bug fixes	New GFS HWRF with infrastructure upgrades. Some physics and dynamics upgrades.	All physics upgrades	Wave coupling included	Final HWRF config	NCO runs parallel of fake storms to test dataflow. Customers verify. Repeat until approval.
Cases	Limited Storms 2011-2015	2013-2015 All AL CP EP	2013-2015 Mostly AL CP EP	2013-2015 Mostly AL CP EP	2013-2015 Storms of wave interest	2013-2015 All Bains	Fake Storms
Platform	WCOSS Jet/Theia	TO4 & Jet	TO4 & Jet	TO4 & Jet	TO4 & Jet	TO4 & Jet	TO4 (NCO)
Dates	2015 June-Jan	2016 Jan-June	2016 Jan-Feb	2016 Jan-Feb	2016 Jan-Feb	2016 Mar-June	2016 May



Support for a WRN
Aviation R&D

FY 16 will continue a small agile portfolio with strong collaboration and coordination with the FAA Aviation Weather Research Program, Aviation Weather Center/Testbed, Alaska Aviation Weather Unit, Center Weather Service Units and NWS Aviation Services .

Collaborations continue across community to develop tools, techniques & technologies to support Digital Aviation Services :

- Winter & Summer Experiments with FAA and Industry are on track

Gridded Guidance & Verification Tools – enhancing ceiling, visibility and convection guidance for aviation

- Ceiling & Visibility (C&V) National Grid: Prototype Development for Cloud Grid
- LAMP - Localized Aviation MOS Product- Improved Lightning & Convection Grids
- AFVT- Aviation Forecast Verification Tool- Prototype capabilities for verification of Digital Aviation gridded Forecasts in NDFD (Begin Transition to Operations)

Digital Aviation Services – moving aviation products from legacy text based to digital/gridded products

- New AWIPS tools for Digital Services
- CL31 PBL - CL31 Planetary Boundary Layer

Decision Support Tools – Impact-Based Decision Support Services for aviation users

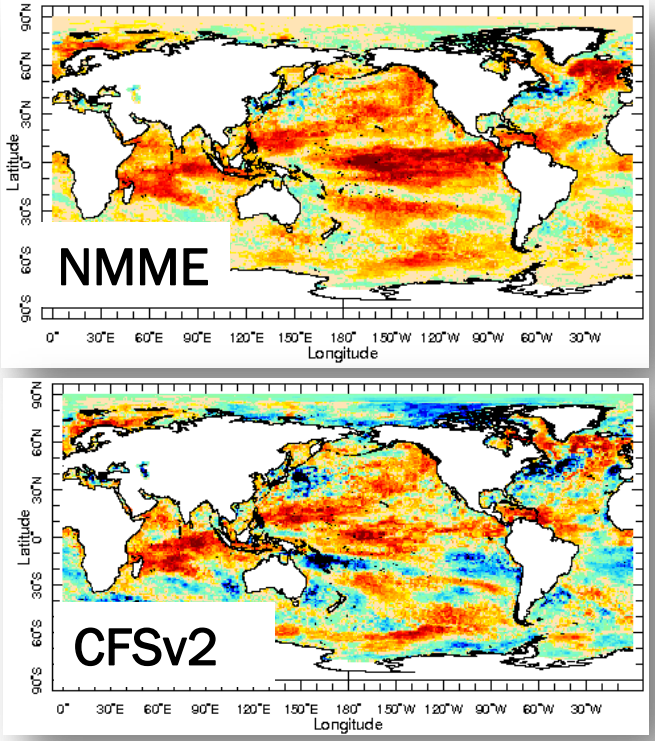
- INSITE - Enhancements to the Integrated Support for Impacted air-Traffic Environments

Support for a WRN

The North American Multi-Model Ensemble

NMME - An unprecedented multi-model system to improve seasonal climate prediction

DJF SST Forecasts July IC (B. Kirtman)



The multi-model approach enhances seasonal predictions beyond individual model predictions.

- Based on leading climate models in the US and Canada (6 models, up to 100 members),
- Contributing experimentally to NOAA operational seasonal outlooks (up to 9 months) since 2011
- Contributing to prediction and predictability research and informing model development
- Will be operational in NCEP late 2015;
- Most comprehensive seasonal prediction data set accessible to the public
  - Real-time at CPC web site
  - Hindcast at IRI and NCAR